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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/360,292	07/22/1999	SUJIT SHARAN	MI22-1106	3962

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EXAMINER	
AHMED, SHAMIM	
ART UNIT	**PAPER NUMBER**
1765	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	09/360,292	SHARAN ET AL.	
	Examiner	Art Unit	
	Shamim Ahmed	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 April 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *15-22 and 35-41* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *15-22 and 35-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 4/30/07 have been fully considered but they are not persuasive. As to 112, second paragraph rejection, the claim 15 is still indefinite because if the plasma is generated from hydrogen gas alone, then the plasma is not forming by utilizing oxygen-comprising gas.

As to Mathews, applicants argue that Mathews does not require any subsequent removal process of the polymer buildup because Mathews suggests that argon physical sputtering is provided for minimizing polymer buildup.

In response, examiner states that the argument is not persuasive because Mathews's argon sputtering is performed to make the contact opening as facet type as well as widening the contact opening (col.3, lines 44-60) and this approach prevent undesired formation of the prior art cusps (col.4, lines 1-4).

Additionally, the above teaching of Mathews has nothing to do with removing the unwanted residue over the base surface.

As to Hillyer, applicant argue that Hillyer does not teach or suggest removal of masking layer and subsequent utilization of an oxygen comprising plasma to remove residue from an outwardly exposed conductive silicon-comprising material.

In response to the argument, examiner states that the argument is not persuasive because Hillyer et al teach in FIG. 3, a via 24 is then etched through the dielectric layer

18 to expose a circuit element below (paragraph 0023 and 0026), wherein the residue is removed from an exposed conductive layer (12) over a silicon-comprising substrate (paragraph 0017).

Furthermore, the primary reference (Mathews et al) already teaches that etching a material to form an opening thereby extending the opening to outwardly expose a material comprising conductive silicon or active region (38) at the base of the opening and obviously leaving residue on all the exposed surfaces after the etching step (see the rejection and figures 4-5).

Examiner also states that the secondary reference (Hillyer et al) relied upon to show the general teaching of using oxygen-comprising plasma in a post-etching of a silicon-comprising substrate in order to provide a cleaner surface for subsequent process (see the rejection).

Therefore, the previous office is repeated herein as follows:

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

3. Claims 15-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

4. In the above claims, the use of the phrase "the plasma comprises hydrogen and more over comprises ammonia" as the plasma is generated from a gas----- consisting of one or more members of the group consisting of O_2, O_3, H_2 and NH_3 renders the claims

indefinite because it is unclear if the plasma is generated from hydrogen gas alone, how the utilized plasma can be oxygen-comprising plasma, assuming the use of hydrogen and ammonia is optional?

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 15,17-20 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Hillyer et al (2006/0128159).

Mathews et al disclose a method of forming a contact to a silicon substrate (36), wherein a contact opening is formed by etching an insulating layer (40) through a

patterned/masked layer (42) over the silicon substrate and the etching extending the opening to expose outwardly a conductive silicon-comprising material as an active region (38) at the base of the opening (col3, lines 21-40 and figure 4).

Mathews et al also disclose that the masking layer is removed using oxygen etching/ashing after the etching process, which forms the contact opening (44) (col.3, lines 43-45 and figure 5).

Mathews et al teach that after removing the masking layer, conductive layer (52,54) is subsequently deposited (col.3, line 65-col.4, line 6 and figure 6).

Mathews et al fail to disclose the introduction of an oxygen-comprising plasma cleaning step to remove a residue from the outwardly exposed silicon-comprising material before the subsequently deposition.

However, in a post-etch treatment method, Hillyer et al teaches that etch-residue is removed by exposing the substrate with a plasma comprising oxygen and hydrogen, wherein the hydrogen plasma can be formed from ammonia (NH_3) (see paragraphs 0028-0029).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Hillyer et al's teaching into Mathews et al's process for efficiently removing the residual material after an etching process as taught by Hillyer et al.

By doing so, one could have a residue-free substrate that will assure the subsequent deposition process is contamination-free.

8. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Hillyer et al (US 2006/0128159) as applied to claims 15,17-20 and 22 and further in view of Allen (5,970,373).

Modified Mathews et al teach above in the paragraph 7 and also teach that the oxygen plasma comprises ozone.

However, in a post-etch treatment method, Allen teaches that the etched dielectric substrate is treated with oxygen-comprising plasma such as ozone (O_3) or oxygen for removing residual matter (col.5, lines 54-65).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Allen's teaching into modified Mathews et al's process for efficiently removing the residual material after an etching process as taught by Allen as both the oxygen and ozone are functionally equivalent.

9. Claims 35 and 38-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Hillyer et al (US 2006/0128159) as applied to claims 15,17-20 and 22 and further in view of Sharan et al (5,747,116).

Modified Mathews et al teach above in the paragraph 7 and also teach that the substrate is a bulk silicon substrate (col.3, lines 21-25) but remain silent about the bulk substrate is a monocrystalline silicon substrate.

However, Sharan et al disclose a method of forming a contact opening in a semiconductor wafer typically comprising a bulk monocrystalline silicon substrate, wherein a contact opening is formed over the silicon substrate and the opening is

extending to expose outwardly a monocrystalline silicon containing material (col.1, lines 24-31, col.3, lines 52-61 and figure 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of claimed invention to modify Mathews et al's bulk silicon substrate with Sharan et al's teaching of using a bulk monocrystalline silicon substrate as a typical silicon wafer substrate as a art recognized substitution for efficiently making electrical contact opening as taught by Sharan et al.

Additionally, Modified Mathews et al discussed above and Mathews et al also disclose that etching the material 40 comprises BPSG immediately beneath the masking material 42 of photoresist (col.3, lines 26-32).

Modified Mathews et al do not explicitly teach that the plasma etching for the carbon- containing polymer residue is substantially selectively relative to the BPSG layer and relative to the silicon-comprising layer.

However, Mathews et al teach that the etching of the BPSG layer is performed using carbon/fluorine based chemistry, it would have been obvious that the residue formed after etching is carbon-containing polymer (col.3, lines 38-40).

As to claims 39-40, Sharan et al teach that cleaning or removing the unwanted material (residue) with hydrogen plasma (col.3, lines 62-67).

10. Claims 21 and 36-37 rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Hillyer et al (US 2006/0128159) as applied to claims 15,17-20 and 22 and in view of Sharan et al (5,747,116) as applied to claims 35 and 38-41 above, and further in view of Brown et al (5,780,359).

Modified Mathews et al discussed above in the paragraph 9 but fail to teach the temperature is at least 400 degree and at least 600 degree C.

However, in a method of removing polymer residue from the surface and sidewalls of a silicon wafer, Brown et al teach that the temperature of the stripping process can be varied from 20 degrees to over 100 degrees C, while the benefits of using higher temperatures includes a rate increase in the chemical portion of the stripping process (col.4, lines 26-33).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to optimize the process temperature to an elevated one because the elevated temperature will increase the rate of reaction of the stripping process as taught by Brown et al.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Lee et al (5,911,835) and Chen et al (5,904,570) both teach removing residual polymer utilizing oxygen plasma.

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (571) 272-1457. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Shamim Ahmed
Primary Examiner
Art Unit 1765

SA
June 11, 2007